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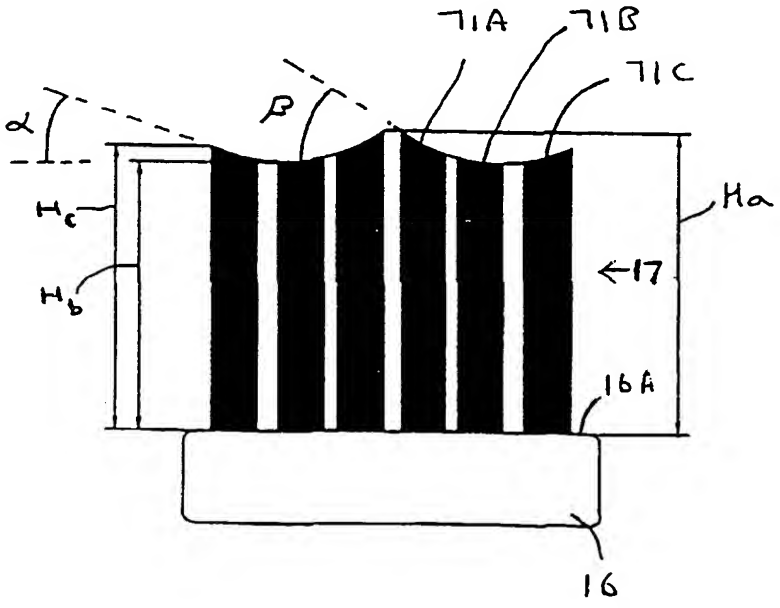
(54) Title: BRUSH PART FOR AN ELECTRIC TOOTHBRUSH



(57) Abstract: A brush part for an electric toothbrush, comprising a bristle holder in which the ends of the bristles remote from the bristle holder lie in a substantially part-cylindrical surface, the length axis of the cylinder being oriented substantially perpendicular to the bristle direction, or are arranged in a pattern of an inner and an outer polygon of tufts of relatively long bristles radially between which there is an intermediate polygon of tufts of relatively less long bristles.

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BRUSH PART FOR AN ELECTRIC TOOTHBRUSH

This invention relates to toothbrushes, in particular to brush parts for electric toothbrushes.

Electric toothbrushes generally have a head which incorporates a brush part which includes a cluster of bristles mounted in a bristle holder, and an electric drive motor located in the brush handle which drives the bristle holder so as to move the bristles in a way which cleans the teeth when the moving bristles are applied to the teeth. A common construction is a holder which is arranged to be rotatable about an axis substantially parallel to the direction of the bristles and passing through the centre of the cluster of bristles.

Such constructions are for example disclosed in US-A- 4479516 and US-A-5652916. Such rotary motion can be oscillatory about this axis, and it is known to move this axis around a conical surface, e.g. in US-A-5862558. It is also known for example from US-A-5577285 for the bristle holder to perform an alternating oscillatory rotary motion and a reciprocal up and down motion in the direction of its axis of rotation, being parallel to the bristle direction. Various configurations of bristles, in terms of the pattern of their bristle cluster in plan as viewed along the bristle direction, are known for use in electric toothbrushes, ranging from simple rings or series of concentric rings of tufts of bristles, to more elaborate configurations. Some such configurations are for example disclosed in US-A-4619009, US-A-5467495, US-A-5625916, US-A-5652990, WO-A-94/21192, WO-A97/01307, WO-A98/26730, and WO-A-99/03372.

It is an object of this invention to provide improved brush parts suitable for an electric toothbrush, particularly having novel bristle configurations. Other objects and advantages of the invention will be apparent from the following description.

According to this invention a brush part for an electric toothbrush is provided, comprising a bristle holder having a cluster of bristles mounted thereon and extending generally in a bristle direction, the bristle holder being connectable to a toothbrush handle containing an electric drive motor and capable of being rotatably driven by the drive motor when connected thereto about a rotation axis

generally transverse to an axis between the brush part and the handle, characterised in that:

the ends of the bristles remote from the bristle holder lie in a substantially part-cylindrical surface, the length axis of the cylinder being oriented substantially perpendicular to the bristle direction.

The term "cylindrical" as used herein includes true cylinders i.e. a shape having straight longitudinal sides and a circular cross section, with the longitudinal axis of the cylinder passing through the centre of the circular section. The term also includes distorted cylinders, e.g. shapes with convex bulging longitudinal sides e.g. "barrel" shapes, and shapes with concave sides, i.e. wider at the cylinder ends than at a waist partway between the ends, provided however that the radius of curvature of the convex or concave sides is greater than the radius of curvature of the cross section shape. Also the term "cylinder" includes such shapes with oval or oblate circular, or polygonal, including polygonal with rounded corners or sides, cross section. A part true cylindrical surface, i.e. curved in an arc of a true circle, is preferred.

Preferably the central longitudinal axis of the cylinder passes through a constructed axis aligned in the bristle direction and passing through the centre of the bristle cluster.

Suitably the curve of the cross section of the part cylindrical surface is such that the difference in length (i.e. from the surface of the holder) between the bristles at the centre of the cluster and the edge of the cluster is in the range 0.2 – 0.01 of width of the cluster across the longitudinal cylindrical axis. This corresponds to a curve of the cross section of the part cylindrical surface such that the ratio of the difference in length between the bristles at the centre of the cluster and the edge of the cluster : width of the cluster across the longitudinal cylindrical axis is in the range 1 : 5 to 1 : 10. It is found that a relatively shallow cylindrical curve of the part cylindrical surface can result in an improved power efficiency of the electric toothbrush, e.g. less battery usage for a given cleaning efficiency. Therefore preferably the said difference in length is in the range 0.05 – 0.08 of the width, more preferably in the range 0.06 – 0.07, e.g. 0.062 – 0.065.

A typical width for the cluster of the brush part of this invention is ca. 10 - 12.5 mm, e.g. 10.5 – 11.5 mm measured perpendicular to the bristle direction. With such a width a suitable radius of curvature of the cross section of the cylindrical surface can be calculated from the above dimensions. With such a width a suitable radius of curvature of the cross section of the cylindrical surface is ca. 8 – 12 mm, e.g. 10 – 11 mm.

Typically the part cylindrical surface may comprise ca. 50 - 75° of the 360° complete circle of the circular cross section of a cylinder, preferably ca. 60 - 70°, for example ca. 65°.

It is preferred that if the bristles are disposed in discrete tufts, e.g. of circular cross section as defined by mounting holes in the holder into which the tufts are fitted, the ends of the bristles remote from the holder in a tuft follow the said part cylindrical shape, e.g. these ends may be cut to follow this shape. Alternatively but less preferred these ends may be cut perpendicular to the bristle direction, e.g. parallel to the face of the holder from which the bristles project, so that these ends follow the part cylindrical surface only in a stepwise manner.

In another aspect of this invention another advantageous bristle configuration for an electric toothbrush is provided.

The configuration of this aspect comprises a bristle holder having a cluster of bristles mounted thereon and extending generally in a bristle direction, the bristle holder being connectable to a toothbrush handle containing an electric drive motor and capable of being rotatably driven by the drive motor when connected thereto about a rotation axis generally parallel to the bristle direction, characterised in that:

the bristles of the cluster are arranged in (i) an outer ring or polygon of outer tufts including relatively long bristles, within which there is (ii) at least one inner tuft including relatively long bristles, and (iii) at least one intermediate ring or polygon of tufts including relatively less long bristles situated radially between the outer ring and the at least one inner tuft.

Preferably there is a plurality of inner tufts (ii) arranged in a ring or polygon of tufts (ii) with a tuft (ii) at each angle of the polygon.

Preferably the ends of the bristles in the outer and inner tufts, and optionally also the intermediate tufts, are cut so that the ends of the tufts are inclined at an

angle which is not perpendicular to the bristle direction so as to slope between the length of the relatively long and less long bristles. In such a surface the ends of the outer tufts slope downwardly toward the centre of the pattern and the end(s) of the inner tuft(s) slopes downwardly outwardly toward the edge of the pattern. Typically the slope of the surface in which the ends of the bristles of the inner tuft(s) lies is steeper, e.g. in the inclusive range 30°-50°, than the slope of the surface in which the ends of the bristles of the outer tufts lie, which may for example slope in the inclusive range 20°-40°.

Preferably therefore the ends of the bristles of the outer tufts lie in a substantially conical or pyramidal surface having its projected apex pointing downward toward the bristle holder. Preferably the ends of the bristles of the inner tuft(s), preferably the said polygon thereof, lie(s) in a substantially conical or pyramidal surface having its projected apex pointing upward away from the bristle holder. Preferably the apex-base axes of these conical or pyramidal surfaces in which the ends of the bristles of the outer and inner tufts lie are both parallel to the bristle direction, are coaxial, and pass through the geometric centre of the bristle cluster as seen in plan looking along the bristle direction downwardly toward the bristle holder. Preferably the ends of the bristles of the intermediate tufts lie in a surface which links the extrapolated sloping surfaces of the inner and outer tufts in a smooth curve. Such a smooth curve surface may comprise one or more conical surfaces.

The term "cone" as used herein, and derived terms such as "conical" includes both true cones having a circular cross section at all points along their apex-base axis and sides which follow a straight line path between their apex and the edge of their base, and distorted cones, e.g. having distorted circular, e.g. oval cross sections, and/or sides which follow a concave or convex curved line.

Similarly the term "pyramid" as used herein, and derived terms such as "pyramidal" includes both true pyramids having a regular polygonal cross section at all points along their apex-base axis and sides which follow a straight line path between their apex and the edge of their base, and distorted pyramids, e.g. having distorted polygonal cross sections, and/or sides which follow a concave or convex curved line.

Typically therefore the surface in which the ends of the tufts lie comprises an outer concave dished or saucer-like surface, with its outer rim defined by the sloping surface of the ends of the outer tufts, and with the inner tufts forming a convex, preferably conical or pyramidal, peak about the centre of the dished or saucer-like surface. At the same radius from the centre of the bristle cluster the bristles are preferably all at the same height from the surface of the bristle holder, so that the ends of the outermost bristles of the outer tufts lie in a plane perpendicular to the bristle direction. The longest bristles of the inner tufts, being preferably those nearest the centre of the cluster in the above-described conical or pyramidal surface, may extend to the same height from the bristle holder as the longest bristles of the outer tufts. The longest bristles of the outer tufts are preferably the outermost bristles of the cluster, particularly in the above-described conical and pyramidal surface. Preferably the longest bristles of the inner tufts are longer than longest bristles of the outer tufts, so that the peak of the inner tufts rises above the plane in which the outermost bristles of the outer tufts lie. Typically the highest bristles of the inner tuft(s) may be ca. 9-15% higher relative to the lowest bristles of the intermediate tufts. Typically the highest bristles of the outer tuft(s) may be ca. 4-10% higher relative to the lowest bristles of the intermediate tufts.

In a further aspect of this invention it has unexpectedly been discovered that the use of bristles longer than the commonly used 8 - 8.5 mm provides an advantageous tooth cleaning effect. Possibly this is due to the greater flexibility of such longer bristles.

Therefore the invention further provides a brush part for an electric toothbrush, comprising a bristle holder having a cluster of bristles mounted thereon and extending generally in a bristle direction, the bristle holder being connectable to a toothbrush handle containing an electric drive motor and capable of being rotatably driven by the drive motor when connected thereto about a rotation axis capable of being rotatably driven by the drive motor when connected thereto about a rotation axis generally transverse to an axis between the brush part and the handle, characterised in that the bristles extend from the holder, i.e. have a length, of 9.0 mm or greater, e.g. up to 10 mm, suitably ca. 9.5 mm. Such longer bristles may be provided on the holder together with shorter bristles, i.e. of a length less than 9.0

mm, e.g. 8.0 - 8.9 mm, e.g. 8.5 – 8.9 mm, typically 8.8± 0.5 mm. Suitably such longer bristles may be provided at the edge of a bristle cluster, with shorter bristles in the inner region, e.g. at the centre of the cluster.

For example in the brush part of the first aspect of this invention the longer bristles at the edge of the cluster may have a length 9.0 - 10.0 mm, e.g. ca 9.5 mm, and shorter bristles at the centre of the cluster and/or across the centre of the cluster in the cylindrical longitudinal axis direction may have a length 8.0 - 9.0 mm, e.g. 8.5 - 8.9 mm typically 8.8± 0.5 mm. Typically therefore in the brush part of the invention the difference in length between longest and shortest bristles may be 0.1 - 2.0 mm, e.g. ca. 0.5 – 1.5 mm, suitably 0.5 – 1.0 mm, typically 0.6 – 0.8 mm. A typical width for the cluster of the invention is again ca. 10 - 12.5 mm, e.g. 10.5 – 11.5 mm measured perpendicular to the bristle direction. Preferably the ends of the bristles of this second aspect of the invention are provided in a part circular surface as in the first aspect of the invention.

The brush part of this invention appears to be suitable for use with most known bristle patterns, i.e. the arrangement of bristles in plan on the holder as viewed down the bristle direction. For example the bristles may be disposed in discrete tufts arranged in concentric rings of tufts or polygons with a tuft at each angle of the polygon, optionally with a single tuft at the centre of the pattern.

One preferred pattern comprises three concentric polygons of tufts, being an inner triangle (preferably equilateral) of tufts surrounded by a first, preferably regular, polygon of 7 to 9, preferably 8 tufts, which is surrounded by a second, preferably regular, polygon of 12 to 16 tufts, preferably 14 tufts. The pattern is preferably symmetrical about the width of the pattern, particularly about the longitudinal axis of the part cylindrical surface. The polygons are suitably regularly spaced from the centre of the pattern.

Another preferred pattern comprises a single tuft at the centre of the pattern, a first, preferably regular, polygon of 5 to 7, preferably 6, tufts surrounding this central tuft, a second, preferably regular, polygon of 12 to 14, preferably 13, tufts surrounding the first polygon, and a third, preferably regular, polygon of 18 to 22, preferably 20 tufts surrounding this second polygon. Suitably regular polygons of

even numbers of tufts have apexes aligned with the length axis of the toothbrush. The polygons are suitably regularly spaced from the centre of the pattern.

The brush part of this invention appears to be suitable for all electric toothbrushes in which the bristle holder is mounted for and moveable in rotary motion about an axis transverse to, preferably substantially perpendicular to, the longitudinal head – handle axis of the toothbrush, substantially parallel to the bristle direction, and passing through or close to the centre of the bristle pattern. Preferably the rotary motion is oscillatory, i.e. involving rotation through an angle in one rotary direction, alternating with rotation through substantially the same angle in the opposite rotational direction. Preferably this rotary motion is combined with reciprocal motion of the bristles along the bristle direction, i.e. up and down the bristle direction. For example the motion of the bristle holder, combining such oscillatory rotary and reciprocal motion, may be reciprocally helical. Suitable drive mechanisms to drive the bristle holder in this way are known, for example in US 5, 577, 285 and the drive speeds, amplitudes, and oscillation frequencies, e.g. ca. 3000- 6000 rpm achievable by means of such known drive mechanisms are believed to be suitable for the brush part of the present invention.

Therefore the invention further provides an electric toothbrush having a brush part as described above. For example the brush part of this invention may be connectable, preferably replaceably connectable, to a toothbrush handle containing an electric drive motor. For this purpose the brush part suitably comprises part of a toothbrush head which is itself provided with connection means by which the brush part may be connected to the handle and to the motor. The brush part may for example be rotatably mounted on the toothbrush head, for example by known means, such as an axle mounting, many types of which are known. The connection means may comprise a hollow neck part extending longitudinally between the head and the handle and enclosing a drive shaft by which the motor can drive the brush part via suitable transmission means. The neck part may itself be connectable, preferably replaceably, at its end remote from the head, to the handle in a manner which also connects the drive shaft to the motor. Alternatively the head may itself be connectable, preferably replaceably, to the neck part at its end remote from the handle, to the neck part in a manner which also connects the drive shaft to the brush

part. Many means by which the motor can drive the shaft and the shaft drive the brush part are known.

Generally an electric toothbrush is an elongate structure which comprises a head (including the brush part) and handle disposed along a head – handle axis being the length of the toothbrush, and for example if the bristle holder performs oscillatory rotary motion the longitudinal axis of the part cylindrical surface may oscillate about a mean alignment perpendicular to the length of the electric toothbrush.

The toothbrush bristle holder and the bristles themselves of the brush part of this invention may be made of materials which are conventional in the field of electric toothbrush manufacture, e.g. respectively of plastics materials and nylon fibres. The plastics material parts of the bristle holder and other plastics material parts of the toothbrush may be made by an injection moulding process, and accordingly the invention further provides a process for making a toothbrush as described herein, comprising injection moulding of plastics material. Further the invention provides an injection mould suitable for use in such a process. The invention will now be described by way of example only with reference to the accompanying drawings in which:

Fig. 1 Shows the overall layout of an electric toothbrush of this invention.

Fig. 2 Shows a plan view of the brush part of the toothbrush of Fig. 1

Fig. 3 Shows a side view of and a cross section through the bristle holder and bristle cluster of the brush part of Fig. 2.

Fig. 4 Shows a plan view of another brush part of the toothbrush of Fig. 1.

Fig. 5 Shows a side view of and a cross section through the bristle holder and bristle cluster of the brush part of Fig. 4.

Fig. 6 Shows a plan view and a cross section of another brush part of the toothbrush of Fig. 1.

Fig. 7 Shows a plan view of the brush part of the toothbrush of Fig. 1 with another bristle configuration.

Fig. 8 Shows a cross section through the bristle holder and bristle cluster of the brush part of Fig. 7 about line D --- D.

Referring to Fig. 1 an electric toothbrush is shown overall in side view 10. The toothbrush 10 comprises a handle 11 by which it may be held, and which includes a drive motor, batteries, controls etc. (not shown). The handle 11 is replaceably connected at link 12, suitably a bayonet connection, to a replaceable section 13 including a head 14 at the end of the section 13 remote from handle 11 and a neck part 15. The assembly of handle 11 replaceable section 13 and head 14 are disposed along the length direction A--A of the toothbrush 10. In the head 14 is mounted a brush part comprising a bristle holder 16, from which a cluster of bristles 17 extend in a general bristle direction B--B generally perpendicular to length A--A. The holder 16 is driven by the motor (not shown) via drive shaft 18 (shown generally) extending along inside the neck part 15. The bristle holder 16 is mounted on an axle (not shown) in head 14 for oscillatory rotation about an axis passing through the centre of the bristle cluster 17 and parallel to the bristle direction B—B and for simultaneous reciprocal movement up and down this axis as shown by the arrows.

In use the holder 16 performs simultaneously an oscillatory, i.e. reversing, rotary motion about an axis of rotation parallel to bristle direction B--B and passing through the centre in plan of the cluster of bristles 17, and a reciprocal motion up and down along the bristle direction B--B. The amplitude of the oscillatory rotary motion is ca. 30° either side of a mean position, and the amplitude of the reciprocal motion is ca. 1.0 mm. Numerous drive mechanisms are known in the art to achieve such motion.

Referring to Fig. 2, a plan view of the bristle cluster 17 is shown, looking down onto the upward facing surface 16A of holder 16 in the bristle direction B--B. The orientation of the toothbrush length direction A--A is shown. The bristles 17 are disposed in discrete circular section tufts 21, each ca. 1.4 mm diameter, set in corresponding mounting holes (not shown) in a conventional manner in the holder 16, which is circular in plan, and oscillatorarily rotatable about an axis passing through its centre. The tufts 21 are arranged in a pattern comprising an innermost equilateral triangle of tufts 21A, surrounded by a regular octagon of tufts 21B, which is in turn surrounded by an outermost regular polygon of 14 tufts 21C. The pattern is symmetrical about an axis C--C, which is perpendicular across the brush

length A--A, and which passes through an apex of the triangle of tufts 21A and the outer polygon of tufts 21C, and through a side of the octagon of tufts 21B. As will be more clearly seen in Fig. 3 the ends of the tufts 21 remote from the holder 16 lie in a cylindrical surface with the length axis of the cylinder being aligned in the direction C—C.

Referring to Fig. 3 a side view of the bristle cluster 17 of Fig. 2 is shown in Fig. 3A, looking in the direction C--C across the length A--A of the toothbrush 10, and Fig. 3B shows a cross section through the cluster 17 looking along the length direction A--A and across the direction C--C of the toothbrush 10.

From Figs. 3A and 3B it is seen that the ends of the bristles 17 remote from the holder 16 lie in a cylindrical surface. Fig. 3A shows the ends of the bristles 17 following the arc of the part circular cross section of the cylindrical surface, the ends of the tufts being profiled, e.g. cut to follow this arc. In Fig. 3B it is seen that the ends of the bristles lie along the straight line of the length axis of the cylindrical surface. Sections through the cluster 17 along other lines, e.g. C'--C', parallel to the direction C--C, i.e. also along the length direction of the cylindrical surface would also show the ends of the bristles of the cluster 17 lying in a straight line. The minimum height of the tufts 21A (measured from the upper surface of the holder 16) of the central triangle is ca. 8.0 mm, and the maximum height of the tufts 21C, i.e. at their outer edge, is ca. 9.5 mm as shown in Fig. 3A. The width of the cluster 17, i.e. the dimension between opposite outermost surfaces of the tufts 21C, is ca. 11.0 mm. Therefore the ratio of the difference in length (i.e. from the surface of the holder) between the bristles at the centre of the cluster and the edge of the cluster : width of the cluster across the longitudinal cylindrical axis is ca. 1 : 7.5. From these dimensions the radius of curvature of the arc of the part cylindrical surface can also be calculated, being in one example ca. 10.5 mm. The arc of the part-cylindrical surface in which the ends of the bristles 21 lie as shown in Fig 3A occupies ca. 65° of the 360° complete circle of the circular cross section shown of the part cylindrical surface.

Fig. 3A also shows generally a transmission part 19 containing an axle hole 110 by which the holder 16 may be mounted for the above mentioned oscillatory rotation and reciprocal motion in head 14 on a pin axle (not shown).

Referring to Fig. 4, a plan view of another bristle cluster 17 is shown, again looking down onto the upward facing surface 16A of holder 16 in the bristle direction B--B. The orientation of the toothbrush length direction A--A is again shown. The bristles 16 are again disposed in discrete circular section tufts 41, each ca. 0.7 mm diameter, set in corresponding mounting holes (not shown) in a conventional manner in the holder 16, which is circular in plan, and oscillatorarily rotatable about an axis passing through its centre. As shown in Fig. 4 the pattern comprises a single tuft 41A at the centre of the pattern, a first regular hexagon of 6 tufts 41B surrounding this central tuft with opposite apexes of the hexagon aligned with the length direction A- -A of the toothbrush, a second polygon of 13 tufts 41C surrounding the hexagon 41B, and a third polygon of 20 tufts 41D surrounding this second polygon 41C. The pattern is again symmetrical about an axis C--C, which is perpendicular to the brush length A--A. As will be more clearly seen in Fig. 5 the ends of the tufts 41 remote from the holder 16 lie in a cylindrical surface with the length axis of the cylinder being aligned in the direction C--C.

Referring to Fig. 5 a side view of the bristle cluster 17 of Fig. 4 is shown in Fig. 5A, looking in the direction C--C across the length A--A of the toothbrush 10, and Fig. 5B shows a cross section through the cluster 17 along the direction A--A across the direction C--C of the toothbrush 10.

From Figs. 5A and 5B it is seen that the ends of the bristles 17 remote from the holder 16 lie in a cylindrical surface. Fig. 5A shows the ends of the bristles 17 following the arc of the part circular cross section of the cylindrical surface, the ends of the tufts being profiled to follow this arc. In Fig. 5A the shortest tuft is the central tuft 41A, with a maximum length of 8.0 mm, and the longest tufts are those 41D of the outer polygon, having a maximum length of 9.5 mm. The width of the cluster 17, i.e. the dimension between opposite outermost surfaces of the tufts 41D is ca. 11.0 mm, and the curvature of the arc of the cylindrical surface can be calculated from this, again in one example being ca. 10.5 mm. In Fig. 5B it is seen that the ends of the bristles lie along the straight line of the length axis of the cylindrical surface. Sections through the cluster 17 along other lines, e.g. C"--C", parallel to the direction C--C, i.e. also along the length direction of the cylindrical surface would also show the ends of the bristles of the cluster 17 lying in a straight

line. The arc of the part-cylindrical surface in which the ends of the bristles 21 lie as shown in Fig 5A occupies ca. 65° of the 360° complete circle of the circular cross section shown of the part cylindrical surface.

Fig 5A also shows generally a transmission part 19 containing an axle hole 110 by which the holder 16 may be mounted for the above mentioned oscillatory rotation and reciprocal motion in head 14 on a pin axle (not shown).

Referring to Fig. 6, Fig. 6A shows a cross section through the cluster 17 along the direction A--A across the direction C–C of the toothbrush 10 and a plan view of the bristle cluster 17 is shown in Fig. 6B, looking in the direction C–C across the length A–A of the toothbrush 10.

The plan view of the bristle cluster 17 of Fig. 6B is the same as that of Fig. 5 (the shaded bristles are merely of a different colour to the non-shaded bristles). In Fig. 6A the shortest tuft is the central tuft 61A, with a maximum length of 8.8 mm, and the longest tufts are those 61D of the outer polygon, having a maximum length of 9.5 mm. The width W- -W of the cluster 17, i.e. the dimension between opposite outermost surfaces of the tufts 61D is 11.1 mm. Therefore the difference in length between bristles 61A and 61D is 0.7 mm, corresponding to 0.063 of the width of the cluster 17.

Another bristle configuration of the invention is shown in Figs. 7 and 8. Referring to Fig. 7, a plan view of the bristle cluster 17 is shown, looking down onto the upward facing surface 16A of holder 16 in the bristle direction B--B. The bristles 17 are disposed in discrete circular section tufts 71, each ca. 1.4 mm diameter, set in corresponding mounting holes (not shown) in a conventional manner in the upward facing surface 16A of holder 16, which is circular in plan, and rotatable about an axis passing through its centre.

The tufts 71 are arranged in a pattern which comprises three concentric polygons of tufts, being an inner equilateral triangle of tufts 71A, an outer polygon 71C of 14 tufts, and between the polygon 71C and the inner triangle 71A, an intermediate regular polygon of 8 tufts 71B. The pattern is symmetrical about the width of the pattern, about a line C - C passing through an apex of the triangle 71A and outer polygon 71C, and through the middle of a side of the intermediate polygon 71B.

Referring to Fig. 8 a cross section through the bristle cluster 17 of Fig. 7 is shown, following the line D - D. From Fig. 8 it is seen that the polygon of outer tufts 71C includes relatively long bristles which rise to their highest point from the bristle holder 16 at the edge of the cluster 17. The bristles in the outer tufts 71C are cut in a gentle curve sloping down toward the centre of the pattern, and so that the ends of the tufts are inclined at an angle α. sloping downwards toward the centre of the cluster. It will be understood that the end surfaces of all the tufts 71C consequently lie in a conical or pyramidal surface with its apex pointing downwards towards the bristle holder 16.

The bristles at the outer rim of the polygon 71C are the highest bristles of the outer tufts 71C and lie in a plane perpendicular to the bristle direction B–B. The triangle of inner tufts 71A also include relatively long bristles. The ends of the bristles in the inner tufts 71A are also cut so that the ends of the tufts 71A are inclined at an angle β, sloping down toward the edge of the cluster 17, such that the ends of the bristles of the inner tufts 71A lie in a substantially conical or pyramidal surface having its projected apex pointing upward away from the bristle holder 16. The slope angle β of the end surfaces of the inner tufts 71A is steeper, ca. 40°, than the slope angle α of the end surfaces of the outer tufts 71C which is ca. 30°. The base-apex axes of these two respective conical surfaces are coaxial, parallel to the bristle direction B–B and pass through the centre of the cluster 17 in plan.

Between the polygons 71A and 71C the intermediate polygon 71B of tufts includes bristles which are relatively less long than the highest bristles of the tufts 71A and 71C. The ends of the bristles of the intermediate tufts 71B lie in a conical surface of less steep slope than the slope angles α or β with its projected apex pointing away from the bristle holder 16 in the bristle direction B—B, and having its base-apex axis coaxial with the other two base-apex axes, and which links the extrapolated sloping surfaces of the inner 71A and outer 71C tufts in a smooth curve.

The surface in which the ends of the tufts 17 lie consequently comprises a concave dished or saucer-like surface, with its rim defined by the outer tufts 71C, and with the inner tufts 71A forming a convex peak about the centre of the dished or saucer-like surface. At the same radius from the centre of the bristle cluster 17

the bristles are all at the same height from the surface of the bristle holder 16, so that the ends of the outermost bristles of the outer tufts 71C lie in a ring in a plane perpendicular to the bristle direction B–B. The longest bristles of the inner tufts 71A, being those nearest the centre of the cluster 17 are longer than the longest bristles of the outer tufts 71C, so that the peak of the inner tufts 71A rises above the plane in which the outermost bristles of the outer tufts 71C lie. The width of the bristle cluster 17 is ca. 12.5 mm. Typical heights in mm of the bristles of tufts 71A, 71B and 71C from the upward facing surface 16A of bristle holder 16 are respectively Ha = 9.5 mm, Hb = 8.5 mm, Hc = 9.0 mm as shown in Fig. 8.

Claims.

1. A brush part for an electric toothbrush, comprising a bristle holder (16) having a cluster of bristles (17) mounted thereon and extending generally in a bristle direction, the bristle holder (16) being connectable to a toothbrush handle (11) containing an electric drive motor and capable of being rotatably driven by the drive motor when connected thereto about a rotation axis generally transverse to an axis between the brush part and the handle, characterised in that:

the ends of the bristles (17) remote from the bristle holder (16) lie in a substantially part-cylindrical surface, the length axis of the cylinder being oriented substantially perpendicular to the bristle direction.

2. A brush part according to claim 1 characterised in that the central longitudinal axis of the cylinder passes through a constructed axis aligned in the bristle direction and passing through the centre of the bristle cluster (17).

3. A brush part according to claim 1 or claim 2 characterised in that the curve of the cross section of the part cylindrical surface is such that the difference in length from the surface of the holder (16) between the bristles (17) at the centre of the cluster and the edge of the cluster is in the range 0.2 to 0.01 of the width of the cluster across the longitudinal cylindrical axis.

4. A brush part according to claim 2 wherein the difference in length is in the range 0.05 – 0.08 of the width.

5. A brush part according to any one of claims 1 to 4 characterised in that the part cylindrical surface comprises ca. 50 - 75° of the 360° complete circle of the circular cross section of a cylinder.

6. A brush part according to any preceding claim characterised in that the bristles (17) are disposed in discrete tufts, and the ends of the bristles (17) remote from the holder (16) in a tuft are cut to follow the part cylindrical shape.

7. A brush part according to any one of the preceding claims characterised in that the pattern is symmetrical about the longitudinal axis of the part cylindrical surface.

8. A brush part for an electric toothbrush, comprising a bristle holder (16) having a cluster of bristles (17) mounted thereon and extending generally in a bristle direction, the bristle holder (16) being connectable to a toothbrush handle (11) containing an electric drive motor and capable of being rotatably driven by the drive motor when connected thereto about a rotation axis generally parallel to the bristle direction, characterised in that:

the bristles (71) of the cluster are arranged in at least one inner tuft (71A) including relatively long bristles, an outer ring or polygon (71C) of outer tufts including relatively long bristles, within which there is at least one intermediate ring or polygon of tufts (71B) including relatively less long bristles situated radially between the at least one inner tuft (71A) and the outer ring or polygon (71C).

9. A brush part according to claim 8 characterised by a plurality of inner tufts arranged in a ring or polygon of tufts (71A) with a tuft at each angle of the polygon.

10. A brush part according to claim 8 or 9 characterised in that the ends of the bristles in the inner (71A) and outer (71C) tufts are cut so that the ends of the tufts (71A and 71C) are inclined at an angle which is not perpendicular to the bristle direction so as to slope between the length of the relatively long and less long bristles.

11. A brush part according to claim 10 characterised in that the ends of the bristles of the outer tufts (71C) lie in a surface which slopes downwardly toward the centre of the pattern and the ends of the bristles of the inner tuft(s) (71A) slopes downwardly outwardly toward the edge of the pattern.

12. A brush part according to claim 11 characterised in that the slope of the surface in which the ends of the bristles of the inner tuft(s) (71A) lie is steeper than the slope of the surface in which the ends of the bristles of the outer tuft(s) (71B) lie.

13. A brush part according to any one of claims 8 to 12 characterised in that the ends of the bristles of the outer tufts (71C) lie in a substantially conical or pyramidal surface having its projected apex pointing downward toward the bristle holder and the ends of the bristles of the inner tuft(s) (71A) lie(s) in a substantially conical or pyramidal surface having its projected apex pointing upward away from the bristle holder.

14. A brush part according to any one of claims 8 to 13 characterised in that at the same radius from the centre of the bristle cluster the bristles (71A, 71B, 71C) are all at the same height from the surface (16A) of the bristle holder (16), so that the ends of the outermost bristles of the outer tufts (71C) lie in a plane perpendicular to the bristle direction.

15. A brush part according to claim 14 characterised in that the longest bristles of the inner tufts (71A) extend to the same height Hb from the bristle holder (16) as the longest bristles of the outer tufts (71C), or are longer than the longest bristles of the outer tufts (71C) so that the peak of the inner tufts (71A) rises above the plane in which the outermost bristles of the outer tufts (71C) lie.

16. A brush part according to any preceding claim characterised in that the bristles (17, 71) are disposed in discrete tufts (21, 41, 61, 71) arranged in concentric rings or polygons with a tuft at each angle of the polygon.

17. A brush part according to claim 16 characterised in that the bristles (17) are disposed in a pattern which comprises three concentric polygons of tufts, being an inner triangle of tufts (21A, 71A) surrounded by a first polygon (21B, 71B) of 7 to 9 tufts, which is surrounded by a second polygon (21C, 71C) of 12 to 16 tufts.

18. A brush part according to claim 16 characterised in that the bristles (17) are disposed in a pattern which comprises a single tuft (41A) at the centre of the pattern, a first polygon of 5 to 7 tufts (41B) surrounding this central tuft, a second polygon of 12 to 14 tufts (41C) surrounding the first polygon, and a third polygon of 18 to 22 tufts (41D) surrounding this second polygon (41C).

19. A brush part according to any preceding claim characterised in that the brush part is mounted for and moveable in rotary motion about an axis substantially perpendicular to the longitudinal head (14) – handle (11) axis of the toothbrush, substantially parallel to the bristle direction, and passing through or close to the centre of the bristle pattern (17).

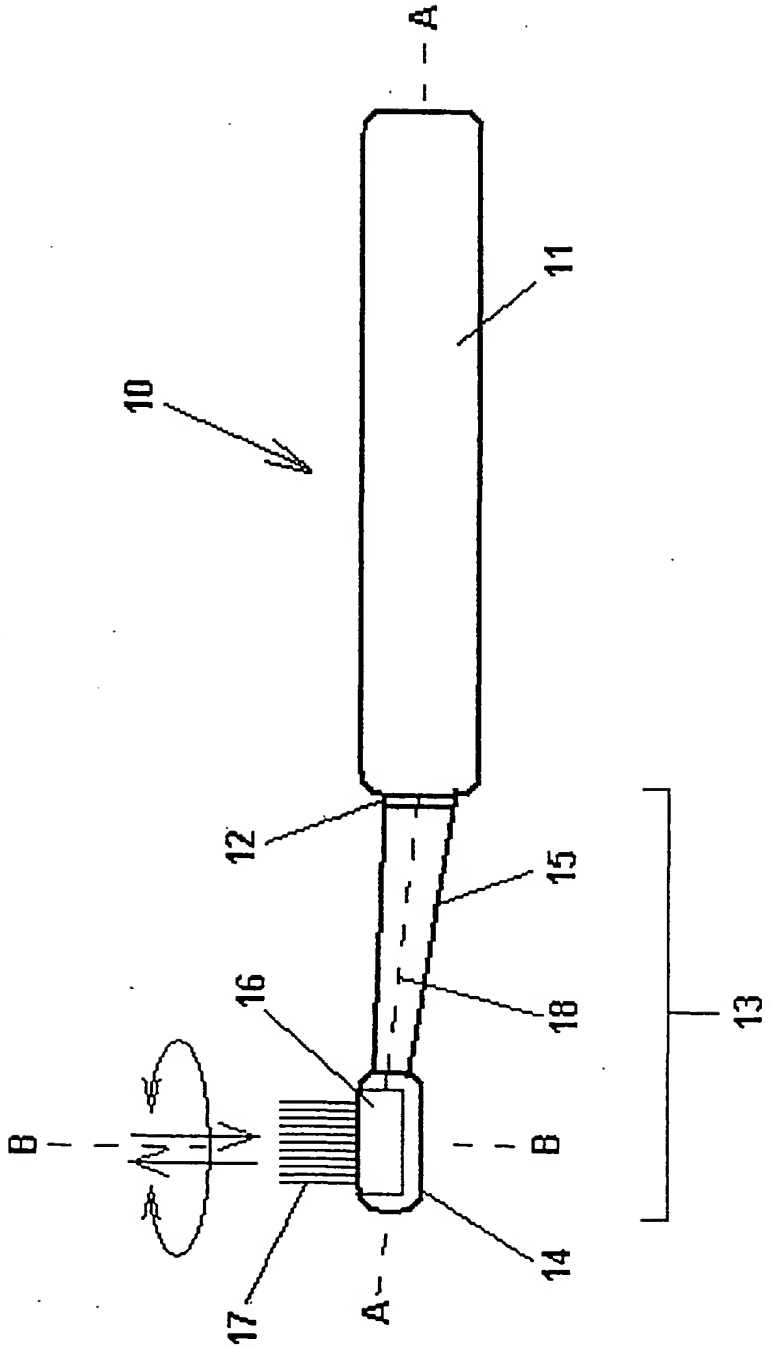
20. A brush part according to claim 19 characterised in that the rotary motion is oscillatory involving rotation through an angle in one rotary direction, alternating with rotation through the same angle in the opposite rotational direction.

21. A brush part according to claim 19 or 20 characterised in that the rotary motion is combined with reciprocal motion of the bristles (17) along the bristle direction, up and down the bristle direction.

22. An electric toothbrush characterised by a brush part according to any one of the preceding claims.

23. An electric toothbrush according to claim 22 characterised in that the bristle holder (16) is mounted to perform oscillatory rotary motion such that the longitudinal axis of the part cylindrical surface oscillates about a mean alignment perpendicular to the length of the electric toothbrush.

Fig. 1



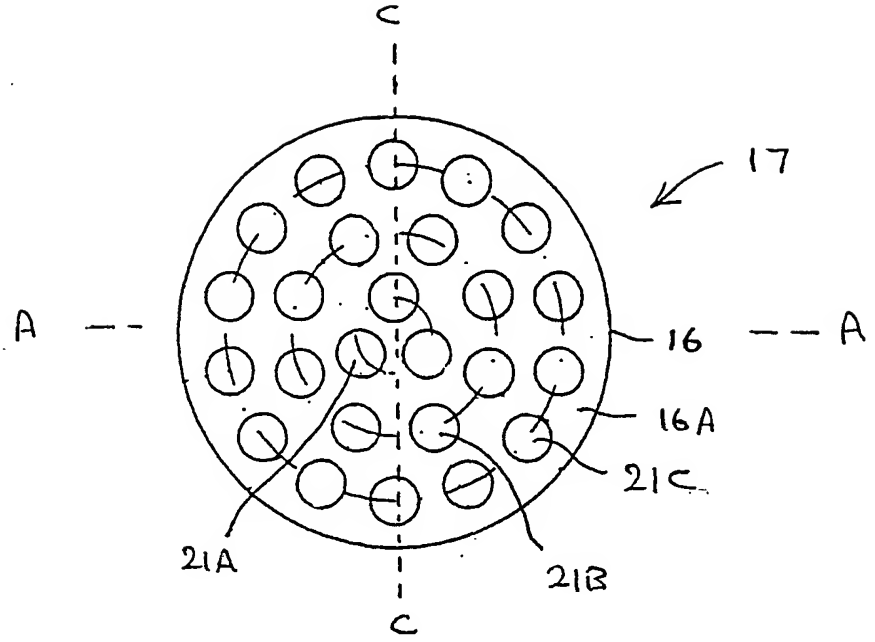


Fig. 2

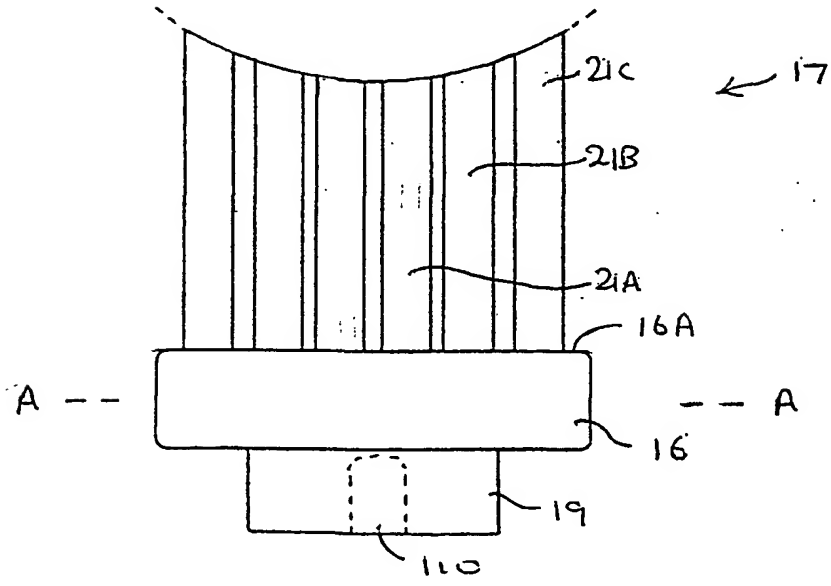


Fig. 3A

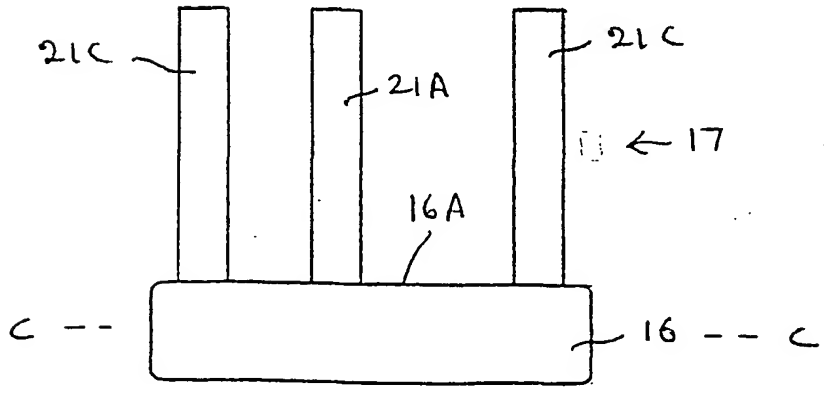


Fig. 3B

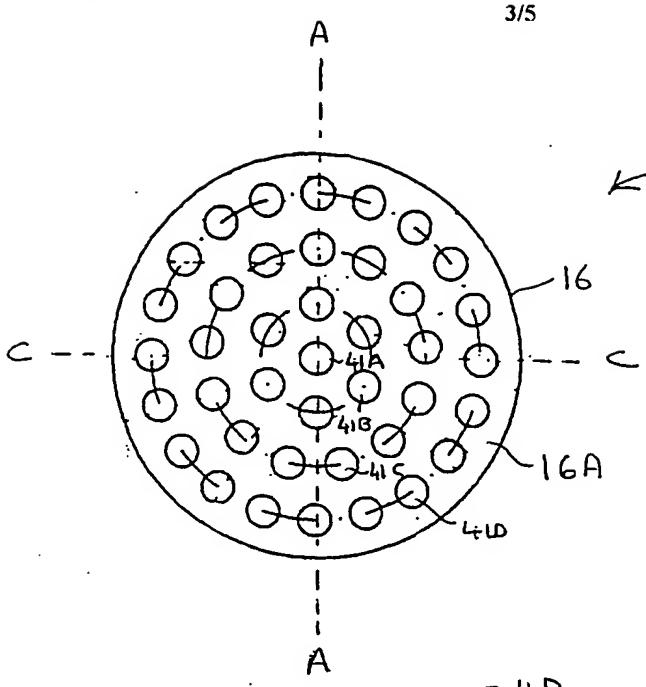


Fig. 4

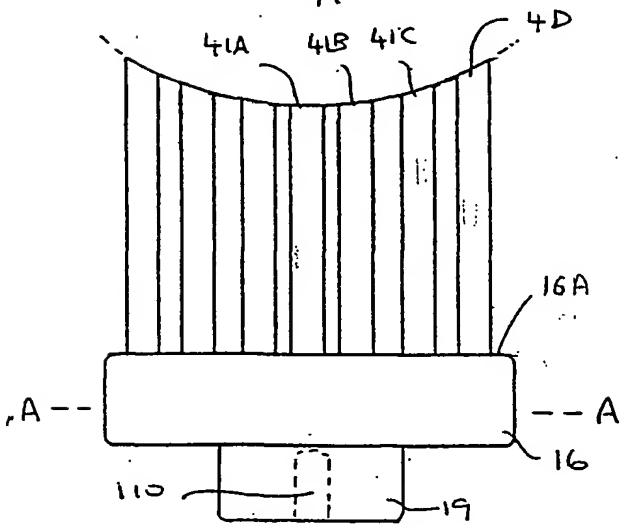


Fig 5A

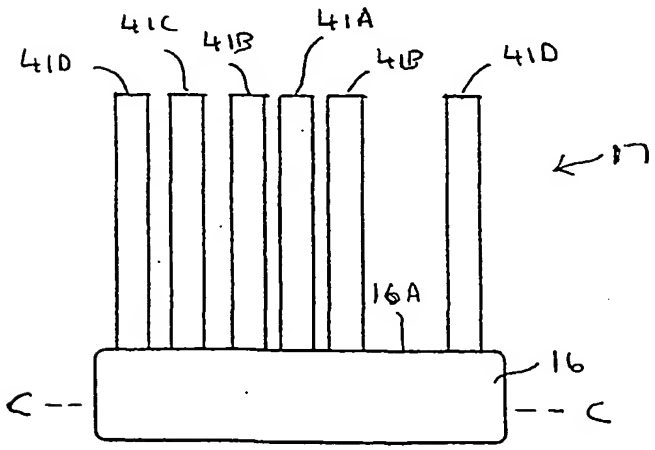


Fig. 5B

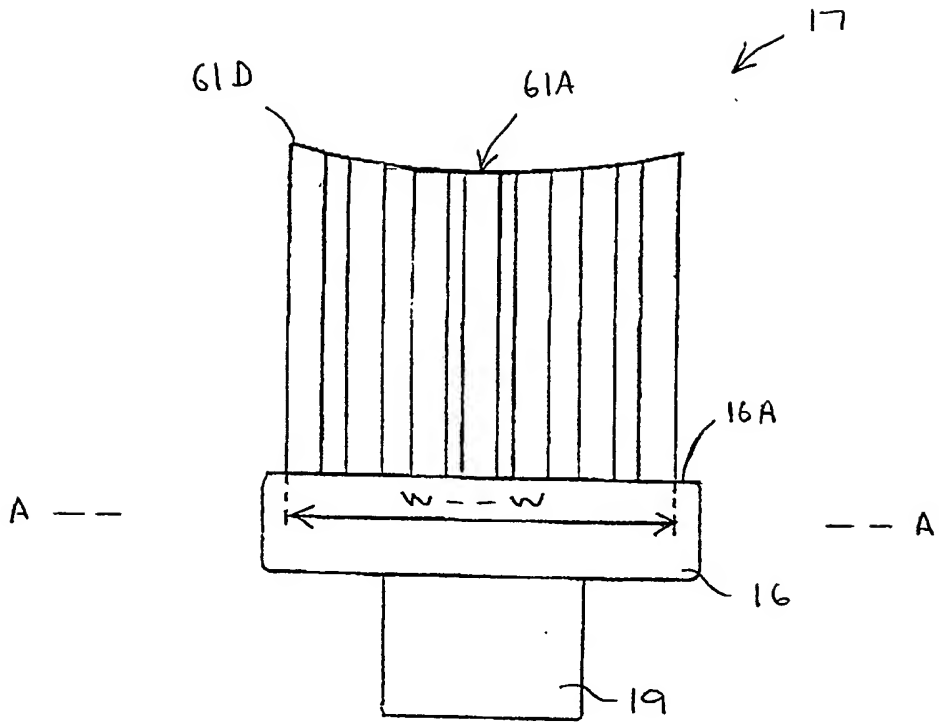


Fig 6A

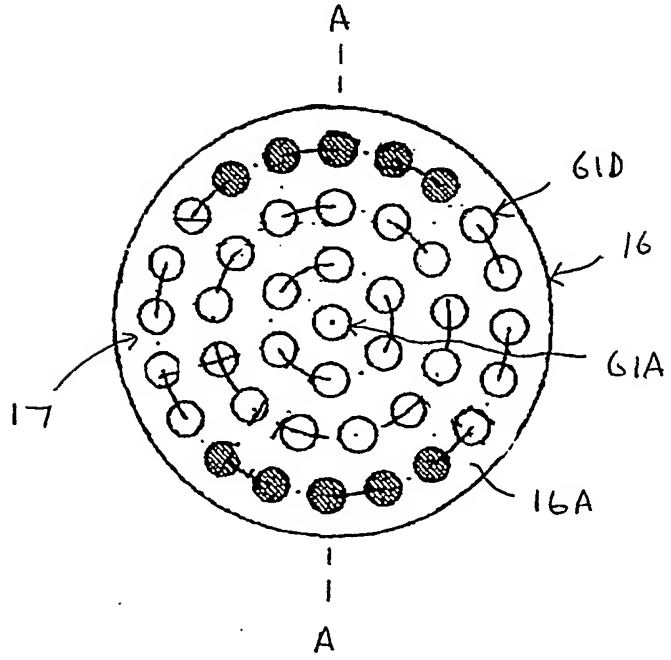


Fig 6B

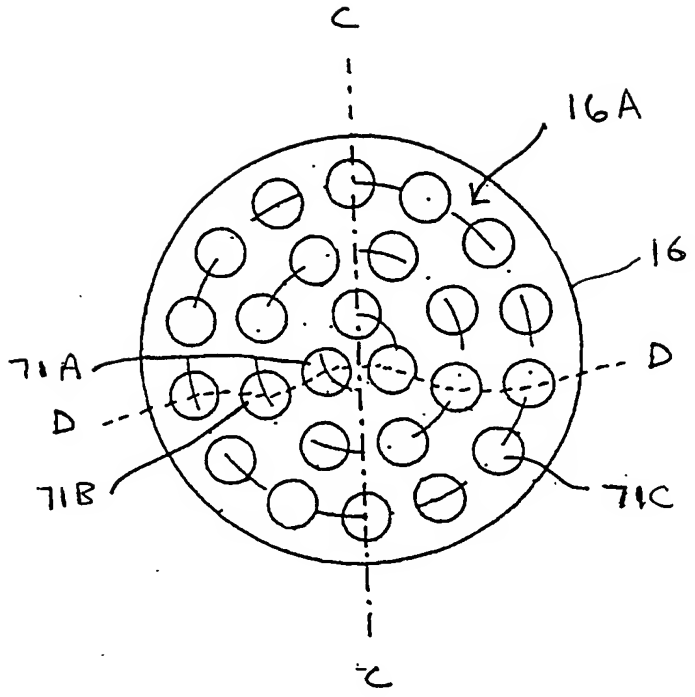


Fig. 7

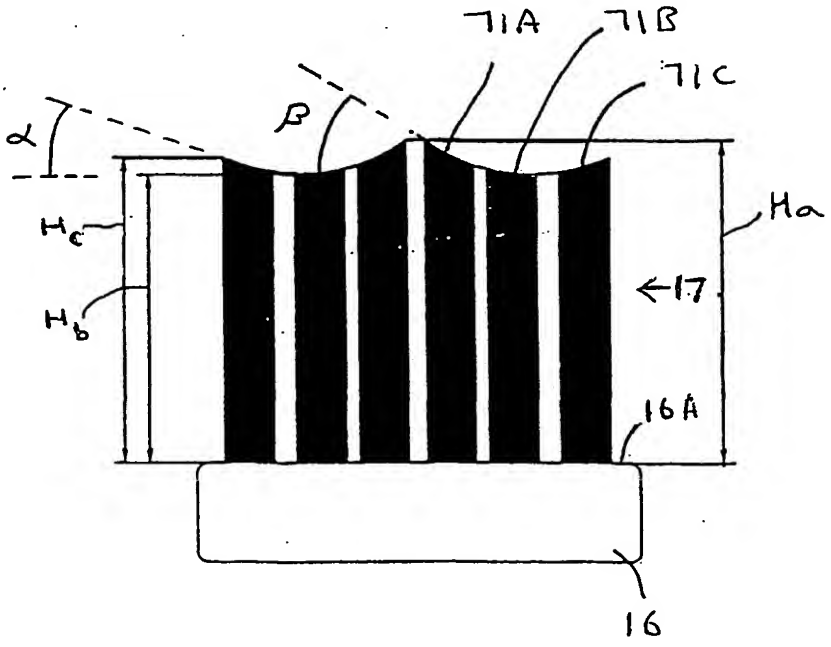


Fig. 8

INTERNATIONAL SEARCH REPORT

tional Application No
PCT/EP 01/01464

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A61C17/22 A61C17/26 A61C17/34 A46B9/04 A46B13/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A46B A61C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	page 11, line 19 -page 12, line 2 page 14, line 23 -page 15, line 13 page 17, line 29-33 page 18, last paragraph figure 5	21

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A	page 5, line 1-22 page 9, line 21 -page 10, line 14 page 11, line 2-27 page 17, last paragraph figures 1-9	20

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 July 2001	24/07/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Salvignol, A

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INTERNATIONAL SEARCH REPORT

tional Application No
PCT/EP 01/01464

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	US 5 518 300 A (MEYER BERTHOLD) 21 May 1996 (1996-05-21) column 1, line 40-53 column 3, line 23 -column 4, line 14 figures 1,2	10-13
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PCT/EP 01/01464

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